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ITS RANGE USE AND FOOD HABITS IN
CENTRAL MONTANA WITH SPECIAL
REFERENCE TO WHEAT

By
GLEN F. COLE and BRUCE T. WILKINS

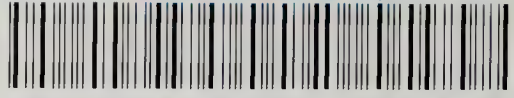
TECHNICAL BULLETIN

Technical Bulletin No. 2

MONTANA FISH AND GAME DEPARTMENT

JULY, 1958

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THE PRONGHORN ANTELOPE

ITS RANGE USE AND FOOD HABITS IN CENTRAL MONTANA WITH SPECIAL REFERENCE TO WHEAT¹

GLEN F. COLE AND BRUCE T. WILKINS²

INTRODUCTION

Throughout much of Montana's plains region, populations of pronghorn antelope (*Antilocapra americana*) occur in proximity to land areas devoted to wheat production. Antelope are frequently observed on wheat fields. Landowners over much of the wheat growing region express little concern, but reports from localized areas have alleged serious damage to wheat as a result of antelope using fields.

Considerations of agricultural interests are essential in managing the antelope resource. The relationship of antelope habits to wheat production had not been thoroughly investigated in Montana. A two-year study was conducted from May 1955, to May 1957, to obtain information on this subject. A 184 square mile area in southern Chouteau County, 36 miles northwest of Lewistown, was selected for the study. This area was selected because it had a relatively high antelope population which had been reported to be in conflict with wheat production. A railroad track, bounded by antelope proof fences, divided the study area into a western section of approximately 126 square miles and an eastern section of approximately 58 square miles (Fig. 1). An August 1955, aerial census indicated a summer population of about 2 antelope per square mile for the western section, 3 per square mile for the eastern.

The principal economy of the area was dry land wheat farming and cattle raising. All lands were privately owned or leased. The climate of the area is characterized by moderately low rainfall, hot summers, cold winters and a large proportion of sunny days (Gieseke, 1931). Average annual precipitation at a local weather station (Geraldine) was

¹ A contribution from Federal Aid to Wildlife, Montana Project W-37-R. Thanks are extended to Dr. Don C. Quimby, Montana State College, for reviewing the manuscript. Dr. Charles J. Mode, Montana State College, aided in the application of statistical treatments.

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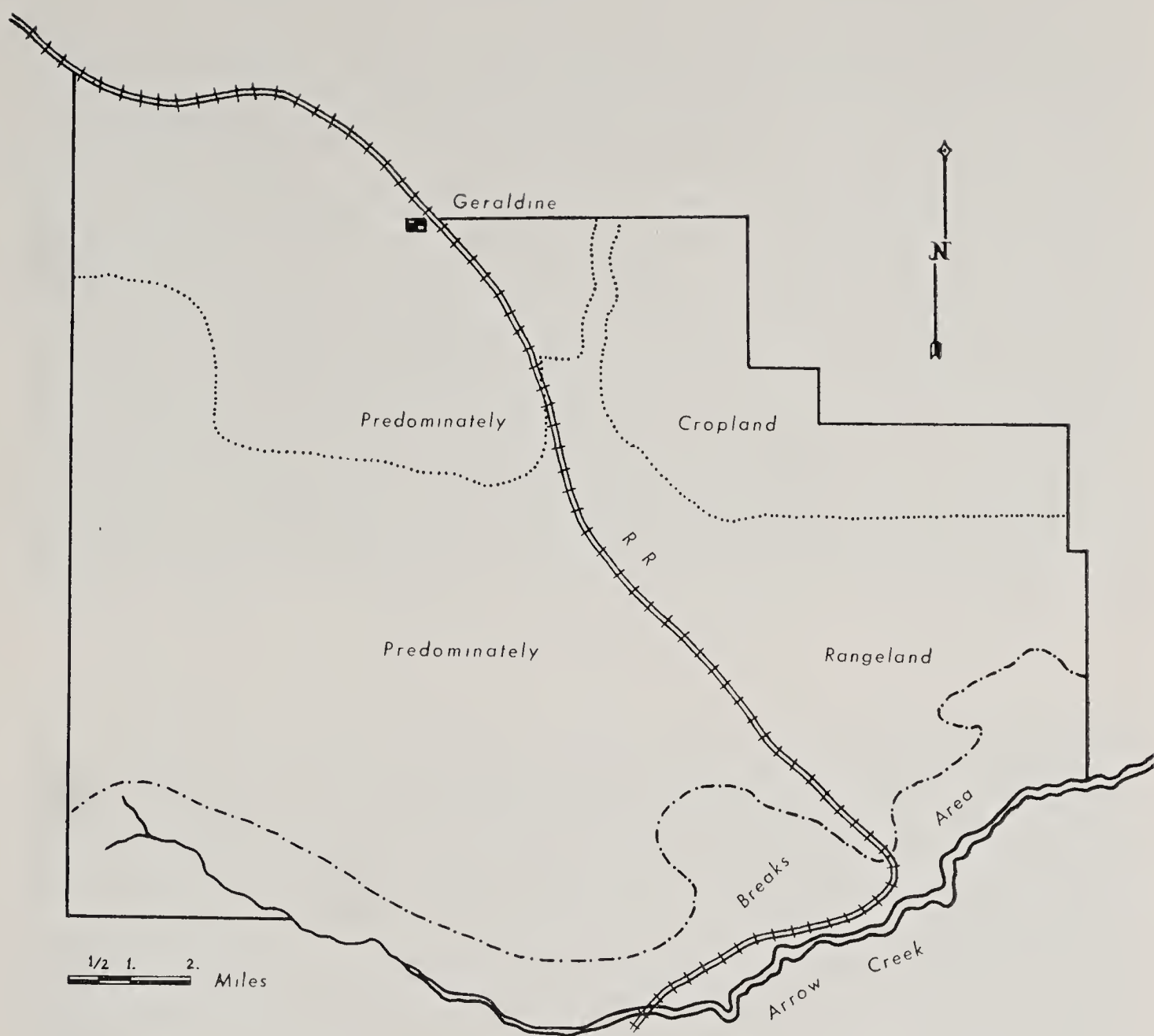


Fig. 1. Map of the study area.

15.16 inches (U. S. Department of Commerce). The area was within the glaciated portion of the Great Plains. Soils ranged from heavy clay loams to stony loams. Characteristic physiographic features were upland benches, steep slopes and bottomland flats. Isolated basaltic dikes and buttes occurred on the western section.

Upland benches were broad and extensive on the northern third of the study area. On the remaining two-thirds, the topography was much rougher. Dissected benchlands graded into sharply rolling hills and finally, rough "breaks." The rough "breaks" topography occurred as a belt along the south boundary of the study area. Bottomland flats occurred along some of the larger streams on the area.

VEGETATION OF THE STUDY AREA

Production and Marketing Association records for 1957 show that cropland comprised about 20 per cent of a 248 square mile area which included most of the study area. Rangeland comprised about 80 per cent. The northern third of the study area was predominately cropland (Fig. 1). Interspersed rangeland was confined to sites too rough for cultivation or to areas where landowners engaged in cattle raising. The remaining two-thirds of the study area was predominately rangeland. Interspersed cropland was confined to bottomland flats. Three types of rangeland and two types of cropland were recognized as being available to antelope. Plant nomenclature largely follows the American Joint Committee on Horticultural Nomenclature (1942).

Rangeland Types

Grassland.—This type comprised the major portion of the rangeland area. Recognition was by the dominant aspect of certain grasses. Needle and thread (*Stipa comata*) or bluebunch wheatgrass (*Agropyron spicatum*) was the dominant grass on upland bench and slope sites, western wheatgrass (*Agropyron smithii*) on bottomland sites. Various browse species occurred on sites which were typed as grassland. The species were the same as those found on the two other rangeland types, but their stature and density was such that grasses provided the dominant aspect.

Silver Sagebrush-grassland.—This type occurred on the steeper slopes, within the grassland type north of the rough "breaks" area (Fig. 2). It also occurred within depressions and drainage courses throughout the study area (Fig. 3). Recognition was by the dominant aspect of silver sagebrush (*Artemisia cana*). Characteristic associated grasses on steep slopes were bluebunch wheatgrass and/or little bluestem (*Andropogon scoparis*); within depressions and drainage courses, western wheatgrass and bluegrass (*Poa* sp.).

Big Sagebrush-grassland.—This type occurred on ridges and slopes within the rough "breaks" area (Figs. 3 and 4). Recognition was by the dominant aspect of big sagebrush (*Artemisia tridentata*). Various grasses common to the other types were present.



Fig. 2. Silver sagebrush-grassland on a steep slope within the extensive grassland type north of the "breaks" area and south of the extensive grain field type.



Fig. 3. Silver sagebrush-grassland along a drainage course in the "breaks" area. The big sagebrush-grassland type occurs on ridges in the background. The grassland type occurs between the two sagebrush-grassland types.

Cropland Types

Grain Fields.—Fields of winter wheat comprised practically all of the cropland type. They were confined to the bottomland flats or the tops of benches. Fields occurred as



Fig. 4. Rough "breaks" area with big sagebrush-grassland on ridges and steep slopes in the background. The grassland type occurs on the gentle slopes and the silver sagebrush-grassland type occurs along the drainage courses in the foreground and center.

small isolated tracts or as extensive tracts of mile after mile of cropland. Wheat crops and summer fallow were alternated in a strip-farming pattern. Crops of spring wheat and barley were occasionally grown. Winter wheat was seeded during the fall. It sprouted the same fall or the following spring. Crops were harvested in late summer or early fall. Spring wheat and barley were seeded in spring and harvested in fall.

Hay Fields.—Two alfalfa fields comprising about 153 acres and two crested wheat fields comprising 89 acres occupied bottomland sites within areas frequented by antelope. None of the fields were enclosed within antelope-proof fences.

ANTELOPE USE OF VEGETATIONAL TYPES

Vehicle routes were traveled through the study area from May 1955, to May 1957. Numbers of antelope seen on the various rangeland and cropland types were recorded. The numbers observed on each type (during a seasonal period) were expressed as percentages to indicate relative intensities of seasonal use. Seasonal percentages were averaged to indicate relative intensities of yearlong use. The results are shown in Table 1.

Table 1.—Total number of antelope observed along routes and the percentages observed during seasonal periods on the various rangeland and cropland types from May 1955, to May 1957.

| | Spring Mar. 16-May 31 | Summer June 1-Sept. 15 | Fall Sept. 16-Nov. 30 | Winter Dec. 1-Mar. 15 | Yearlong |
|---------------------------------|--------------------------|---------------------------|--------------------------|--------------------------|----------|
| Total Antelope Observed..... | 4940 | 6031 | 6858 | 10416 | 28245 |
| Rangeland and cropland types | | | | | |
| Grassland..... | 48 | 59 | 27 | 15 | 37 |
| Silver Sagebrush-grassland..... | 14 | 23 | 33 | 25 | 24 |
| Big Sagebrush-grassland..... | 21 | 5 | 10 | 32 | 17 |
| Grain fields..... | 15 | 11 | 30 | 28 | 21 |
| Hay fields..... | 2 | 2 | 0 | 0 | 1 |

The data suggested that antelope used rangeland types more than cropland types during all seasons. Numbers on the three rangeland types represented about 83 per cent of the total observed during spring, 87 per cent during summer, 70 per cent during fall and 72 per cent during winter. On a yearlong basis, rangeland used averaged about 78 per cent of the total, grain field use 21 per cent and hay field use 1 per cent.

The extensive grassland type received appreciable (about $\frac{1}{4}$ or more of the total use) intensities of antelope use during all seasons except winter. Use of this type was at a maximum during summer. The minor (in size) silver sagebrush-grassland type received appreciable intensities of use during all seasons except spring. Use of this type was at a maximum during fall. The minor big sagebrush-grassland type received appreciable intensities of use only during spring and winter. Use was at a maximum during the winter period.

Grain fields received appreciable intensities of use only during fall and winter. Use was at a maximum during the winter of the first year of the study and the fall of the second (see section on intensities of field use). Hay fields received relatively minor use during the spring and summer. Spring use was predominately on crested wheat fields. Summer use was on alfalfa fields.

The apparent differences in the use of the various types appeared to be related to weather conditions, animal habits and forage preferences. These relationships are covered in the following sections.

FOOD HABITS

Two methods were used to determine antelope food habits: analyzing rumen samples and recording plant use at feeding sites.

One quart rumen samples were obtained from 41 antelope. Eleven were hunter or predator kills and 30 were collected specifically for this study. Collection dates were generally on or about the 12th and 22nd day of a month. Samples obtained prior to the 16th day of any month are later referred to as early samples. Those obtained on or after the 16th are referred to as late samples.

The samples were preserved in 10 per cent formalin in the field. In the laboratory they were washed on a 3 mm. screen. Material remaining on the screen was placed in a pan containing water. Various plant items were segregated. Identifications to species, genus, family or general group were made with the aid of a reference plant collection. The various items were blotted between paper towels to remove excess moisture and volumes were measured to the nearest 0.5 cc. in a 50 cc. graduate. Items less than 0.5 cc. were considered traces. Items constituting 0.5 cc. or more of a sample were expressed as percentages. The percentage that any one item represented in two or more samples was computed by the aggregate percentage method (Martin, *et al.*, 1946). Results are shown by seasons in Table 2.

The term "sprouted grain" was used to describe wheat plants from the newly sprouted to the fully-headed dry stages of development. Except for its occurrence as volunteer plants on the fallow or stubble portions of fields, sprouted grain represented the wheat crop prior to harvest. The term "waste grain" was used to describe the heads and vegetative parts of wheat or barley plants which were left in the stubble portions of fields after the crop had been harvested. The general category designated as grass was used to describe native and exotic species which commonly grew on the rangeland types of the study area.

The unit for recording one instance of plant use was a rooted stem for grasses and forbs and an individual leader for browse. Most feeding sites were examined immediately after antelope had been observed to feed on them. Only fresh use was recorded. Some sites were examined after antelope had been observed to feed on them for several days. This was possible only where the animals had just moved into an area which was not being grazed by livestock. A total of 31,765 instances of plant use was recorded at 194 feeding sites. Results by forage classes are shown in Table 3.

Spring (March 16 - May 31)

Six rumen samples (two each from March, April and May) were analyzed. Browse represented 60 per cent of the sample volumes; forbs, 14 per cent; grass, 11 per cent; waste grain, 15 per cent. Silver sagebrush, western snowberry

Table 2.—Antelope food habits as determined by the analysis of 41 rumen samples. (T=trace—less than 0.5 cc. or less than 1 per cent of the sample contents)

| PLANTS | Spring 6 Rumen Samples % Vol. | Summer 11 Rumen Samples % Vol. | Fall 11 Rumen Samples % Vol. | Winter 13 Rumen Samples % Vol. |
|---|--|---|---------------------------------------|---|
| <i>Artemisia cana</i> —silver sagebrush | 21 | 7 | 39 | 27 |
| <i>Artemisia tridentata</i> —Big sagebrush..... | 17 | | 21 | 42 |
| <i>Symphoricarpos occidentalis</i> —Western snowberry..... | 19 | 17 | 12 | T |
| <i>Rosa arkansana</i> —Arkansas rose..... | 1 | 2 | T | |
| <i>Chrysothamnous nauseosus</i> —Rubber rabbitbrush..... | T | T | 7 | T |
| <i>Juniperus sp.</i> —Juniper | 2 | | | T |
| <i>Rhus trilobata</i> —Skunkbrush sumac..... | | 7 | | |
| <i>Artemisia frigida</i> —Fringed sage..... | T | | T | 1 |
| <i>Yucca glauca</i> —Small soapweed..... | T | T | T | T |
| <i>Prunus virginiana</i> —Common chokecherry..... | T | 1 | | |
| <i>Opuntia fragilis</i> —Brittle prickley pear..... | T | | 1 | T |
| <i>Eurotia lanata</i> —Common winter fat..... | | | T | T |
| <i>Atriplex confertifolia</i> —Shadscale saltbush..... | | | | T |
| Browse Totals | 60 | 34 | 80 | 70 |
| <i>Comandra pallida</i> —Common comandra..... | 12 | T | T | T |
| <i>Phlox hoodii</i> —Hoods phlox..... | 1 | | | T |
| <i>Helianthus sp.</i> —Sunflower | 1 | | | |
| <i>Aster commutatus</i> —Aster | T | 20 | 1 | T |
| <i>Tragopogon dubius</i> —Meadow salsify..... | T | 9 | T | T |
| <i>Psoralea tenuiflora</i> —Slimflower surfeea..... | T | 5 | T | |
| <i>Artemisia ludoviciana</i> —Cudweed sagewort..... | T | 4 | 5 | T |
| <i>Petalostemum spp.</i> —Prairie clover..... | | 3 | | |
| <i>Astragalus spp.</i> —Milkvetch | T | 1 | 1 | |
| <i>Haplopappus spp.</i> —Goldenweed | | 1 | T | T |
| <i>Lactuca scariola</i> —Prickly lettuce..... | | 3 | | |
| <i>Linum rigidum</i> —Stiffstem flax..... | | 3 | | |
| <i>Liatris punctata</i> —Dotted grayfeather..... | | 2 | | |
| <i>Antennaria sp.</i> —Pussytoes | T | T | 1 | |
| <i>Taraxacum sp.</i> —Dandelion | T | | 1 | |
| <i>Besseyia cinerea</i> —Synthyris | T | | | |
| <i>Fritillaria pudica</i> —Yellow fritillary..... | T | | | |
| <i>Ranunculus glaberrimus</i> —Sagebrush buttercup..... | T | | | |
| <i>Gaura coccinea</i> —Scarlet gaura..... | T | | | |
| <i>Vicia sparsifolia</i> —Narrowleaf vetch..... | T | | | |
| <i>Chenopodium album</i> —Lamsquarters goosefoot..... | T | | | |
| <i>Musineon divaricatum</i> —Biscuitroot | T | | | T |
| <i>Polygonum spp.</i> —Knotweed | T | | | |
| <i>Medicago sativa</i> —Alfalfa | | T | | |
| <i>Lygodesmia juncea</i> —Skeleton plant..... | | T | T | |
| <i>Galium sp.</i> —Bedstraw | | | T | |
| <i>Achillea lanulosa</i> —Western yarrow..... | | | T | |
| <i>Astragalus crassicaarpus</i> —Ground plum milkvetch..... | | | T | |
| <i>Salsola kali</i> —Common Russian thistle..... | | | | T |
| <i>Cerastium arvense</i> —Starry cerastium..... | | | | T |
| <i>Cirsium sp.</i> —Thistle | | | | T |
| <i>Solanum sp.</i> —Nightshade | | | | 1 |
| Unidentified forbs | T | 3 | T | 1 |
| Forb Totals | 14 | 54 | 9 | 2 |
| Grass Totals | 11 | 2 | 1 | T |
| Sprouted Grain Totals..... | | 10 | 9 | 5 |
| Waste Grain Totals..... | 15 | | 1 | 23 |

Table 3.—Total instances of plant use and the percentage use by forage classes at 194 antelope feeding sites on various rangeland and cropland types. *==less than 1 per cent. **==use undetected.

| Seasons | Total instances plant use | RANGELAND TYPES | | | | | | | | | | | | CROPLAND TYPES | | | | | |
|---------|---------------------------|--------------------|-------|-------|--|-------------------------------------|-------|-------|--|----------------------------------|-------|-------|--|-----------------------|-------|-------|---------------------|-------|-------|
| | | Grassland Per Cent | | | | Silver Sagebrush-Grassland Per Cent | | | | Big Sagebrush-Grassland Per Cent | | | | Grain Fields Per Cent | | | Hay Fields Per Cent | | |
| | | Browse | Forbs | Grass | | Browse | Forbs | Grass | | Browse | Forbs | Grass | | Browse | Forbs | Grass | Browse | Forbs | Grass |
| Spring | 8568 | 31 | 56 | 13 | | 80 | 14 | 6 | | 90 | 9 | 1 | | ** | 60 | ** | 40 | 10 | 90 |
| Summer | 8168 | 15 | 85 | * | | 57 | 43 | * | | 27 | 73 | ** | | 1 | 55 | 2 | 42 | | |
| Fall | 4192 | 28 | 66 | 6 | | 93 | 7 | * | | 97 | 2 | 1 | | | | 100 | | | |
| Winter | 10837 | 97 | 3 | ** | | 99 | 1 | ** | | 100 | * | ** | | | | 100 | | | |

(*Symphoricarpos occidentalis*) and big sagebrush were the most important browse species. Common comandra (*Comandra pallida*) was the most important forb.

Browse was present in all samples. It was the predominant forage in four (1 March, 1 April, 2 May) where quantities ranged from 80 to 92 per cent. The March sample had big sagebrush as the major food item (92 per cent). The April and early May samples had silver sagebrush as the major food (73 and 42 per cent respectively). Juniper (*Juniperus* sp.) ranked second in the April sample (13 per cent). Western snowberry ranked second in the early May sample (38 per cent). The late May sample had snowberry as the major food (75 per cent). All four samples were from animals collected on the sagebrush-grassland types.

Forbs were also present in all samples, but mainly as trace items. A greater number of species were present in the samples from April and May. One sample from late April had forbs as the predominant food (76 per cent). Common comandra was most important (72 per cent). This sample was from an animal collected on the grassland type.

Grass was present in all but one sample. Quantities in the five where it was present were as follows: March, 4 per cent; early April, 10 per cent; late April, 15 per cent; early May, 20 percent; late May, 16 per cent.

Waste grain was present in one sample (March) where it represented 91 per cent of the contents. Silver sagebrush made up the remaining 9 per cent. One forb occurred as a trace. This sample was from an animal collected on grassland adjacent to a grain field. It was obtained during the first year of the study (May 1955, to May 1956) when sprouted grain was not readily available until mid-spring (see section on field use). During the second year of the study (May 1956, to May 1957), sprouted grain was readily available to antelope through the fall, winter and spring seasons.

A total of 8,568 instances of plant use was recorded at 58 feeding sites as follows: grassland—2,032 instances of use, 26 sites; silver sagebrush-grassland—1,887, 16; big sagebrush-grassland—3,810, 11; hay fields—614, 2; grain fields—225, 3.

Forbs (23 items) received 56 per cent of the use recorded on the grassland type; browse (8 species), 31 per cent; grass, 13 per cent. Meadow salsify (*Tragopogon dubius*), alumroot (*Heuchera* sp.), sagebrush buttercup (*Ranunculus glaberri-mus*), wavyleaf agoseris (*Agoseris cuspidata*) and biscuitroot (*Cogswellia* spp.) were the major forb items, receiving 37 per cent of the use. Silver sagebrush, common winter fat (*Eurotia lanata*) and fringed sage (*Artemisia frigida*) were the most important browse species, receiving 28 per cent of the recorded use.

Seven browse species received 80 per cent of the use on the silver sagebrush-grassland type; forbs (11 items), 14 per cent; grass, 6 per cent. Silver sagebrush, winterfat and fringed sage were the most important browse species, receiving 28 per cent of the recorded use.

Seven browse species received 90 per cent of the use on the big sagebrush-grassland type; forbs (12 items), 9 per cent; grass, 1 per cent. Big sagebrush was the most important browse species, receiving 83 per cent of the recorded use. Common winter fat ranked second (5 per cent). Common comandra, biscuitroot, hoods phlox (*Phlox hoodii*) and wild onion (*Allium* sp.) were the more frequently used forbs.

Forbs (4 items) received 60 per cent of the use recorded on the seeded portion of grain fields. Sprouted grain received 40 per cent. Knotweeds (*Polygonum* spp.) and hares-ear-mustard (*conringia orientalis*) were the most important forbs, receiving 59 per cent of the use.

Grass received 90 per cent of the use recorded on the crested wheat, hay field type. Two forbs (wild onion and meadow salsify) received 10 per cent. Crested wheat (*Agropyron desertorum*) was the most frequently used grass.

Summer (June 1 - September 15)

Eleven rumen samples (2 each from June, July, August, 5 from September) were analyzed. Browse represented 34 per cent of the sample volumes; forbs, 54 per cent; grass, 2 per cent; sprouted grain, 10 per cent. Western snowberry, silver sagebrush, and skunkbrush sumac (*Rhus trilobata*) were important browse species. Aster (*Aster commutatus*) and meadow salsify were the most important forbs.

Browse was present in 10 samples. It was the predominant forage in three (1 August, 2 September) where quantities ranged from 73 to 89 per cent. The August sample had skunkbrush sumac as the major food (50 per cent). Western snowberry ranked second (21 per cent). Silver sagebrush and western snowberry alternated as the first and second most important foods in the two September samples. Combined quantities of these two species represented 70 per cent of one sample, 72 per cent of the other. These two samples were from animals collected on the grassland type. The other sample was from an animal collected on the sagebrush-grassland type where silver sagebrush was dominant.

Forbs were present in all samples. They were the predominant class of forage in seven (2 each June, July and September, 1 August). Quantities ranged from 54 to 98 per cent. Important forbs, making up 25 per cent or more of individual samples, were aster, meadow salsify, stiffstem flax (*Linum rigidum*), slimflower surfpea (*Psoralea tenuiflora*), prairie clover (*Petelostemum* spp.) and prickly lettuce (*Lactuca scariola*). Quantities of browse in these samples ranged from 0 (1 sample) to 43 per cent. Western snowberry, skunkbrush sumac, silver sagebrush and arkansas rose (*Rosa arkansana*) were important. Six of the samples were from animals collected on the grassland type. One was from an animal on the type where silver sagebrush was dominant. Grass was also present in all samples. Quantities in the June and July samples were as follows: early June, 10 per cent; late June, 4; early July, 3; late July, 2. Grass occurred as a trace in the August and September samples.

Sprouted grain was present in four samples (all from late September). It was the major food in one where it represented 63 per cent of the contents. Quantities in the other three ranged from a trace to 28 per cent. The predominant food in these samples was browse or forbs. One of the four samples was from an animal collected on a grain field. Two were from animals collected on grassland. One was from an animal collected on the type where silver sagebrush was dominant. The rangeland types were all adjacent to grain fields.

A total of 8,168 instances of plant use was recorded at 53 feeding sites as follows: grassland—2,384 instances of use, 22 sites; silver sagebrush-grassland—3,968, 18; big sagebrush-grassland—345, 1; grain fields—1,471, 12.

Forbs (22 items) received 85 per cent of the use recorded on the grassland type; browse (6 species) 15 per cent; grass, less than 1 per cent. Aster, meadow salsify, prairie clover and prickly lettuce were the most important forbs (74 per cent of the recorded use). Arkansas rose, skunkbrush sumac and small soapweed (*Yucca glauca*) were the most frequently used browse plants.

Seven browse species received 57 per cent of the use recorded on the silver sagebrush-grassland type; forbs (27 items), 43 per cent; grass, less than 1 per cent. Silver sagebrush, western snowberry and arkansas rose were important browse species (54 per cent of the recorded use). All silver sagebrush use was recorded in late August and September. Aster, cudweed sagewort (*Artemisia ludoviciana*) and prairie clover were the most frequently used forbs.

Forbs (5 items) received 73 per cent of the use recorded on the big sagebrush-grassland type. Browse (big sagebrush only) received 27 per cent. Grass use was not detected. Prairie clover and slimflower surfpea were the most frequently used forbs. All use on this type was recorded during September.

Forbs (7 items) received 55 per cent of the use recorded on the seeded portions of grain fields; sprouted grain, 42 per cent; grass, 2 per cent; browse (rose only), 1 per cent. Knotweed, sunflower (*Helianthus* sp.) and bindweed (*Convolvulus arvensis*) were the most important forbs (49 per cent). On the fallow portions of fields, forbs (12 items) received 79 per cent of the recorded use. Two browse species (rose and western snowberry) received 21 per cent. One instance of use was recorded on volunteer wheat. Bindweed, dandelion (*Taraxacum* sp.) and prickly lettuce were the most frequently used forbs (69 per cent).

Fall (September 16 - November 30)

Eleven rumen samples (2 September, 6 October, 3 November) were analyzed. Browse represented 80 per cent of the sample volumes; forbs, 9 per cent; grass, 1 per cent; sprouted grain, 9 per cent; waste grain, 1 per cent. Silver

sagebrush, big sagebrush and western snowberry were important browse species. Cudweed sagewort was the most important forb.

Browse was present in all samples. It was the predominant forage in nine (1 September, 5 October, 3 November) where quantities ranged from 71 to 100 per cent. Western snowberry was the major food in the September sample (76 per cent). Silver sagebrush or big sagebrush was the major food in the October and November samples. Quantities of one or the other species ranged from 55 to 100 per cent. Western snowberry and rubber rabbitbrush (*Crysothamnus nauseosus*) were important secondary foods in four samples. Amounts ranged from 22 to 41 per cent. Eight of the nine samples were from animals collected on one or the other of the sagebrush-grassland types. One was from an animal collected on a grain field.

Forbs were present in all samples. They were the predominant forage in one (September) where they made up 78 per cent of the contents. Cudweed sagewort was the major food (58 per cent). This sample was from an animal collected on the type where silver sagebrush was dominant.

Grass was present in all but two samples. Quantities ranged from 2 to 3 per cent in three (2 September, 1 October). The remaining six had grass as a trace.

Sprouted grain was present in three samples (2 October, 1 November). It was the predominant food in one (71 per cent) which was obtained during the second year of the study. Silver sagebrush made up the remaining 29 per cent. Quantities in the two other samples from the first year of the study were 9 and 18 per cent. Browse, primarily silver sagebrush, was the major food in these samples (71 and 80 per cent). Waste grain was also present, amounting to 2 and 4 per cent of the contents. One of these samples was from an animal collected on a grain field; the other from an animal collected on the type where big sagebrush was dominant. The sample where sprouted grain was the predominant food was from an animal collected on grassland adjacent to a grain field.

A total of 4,192 instances of plant use was recorded at 31 feeding sites as follows: grassland—573 instances of use, 8 sites; silver sagebrush-grassland—2,627, 20; big sagebrush-grassland—849, 2; grain fields—143, 1.

Forbs (15 items) received 66 per cent of the use recorded on the grassland type; browse (6 species), 28 per cent; grass, 6 per cent. Cudweed sagewort and green wormwood (*Artemisia canadensis*) were the most important forbs (46 per cent). Fringed sage and skunkbrush sumac were the most frequently used browse species (24 per cent). Practically all of the grass use was recorded during the second year of the study when heavy fall rains resulted in a marked "green up."

Six browse species received 93 per cent of the use recorded on the silver sagebrush-grassland type; forbs (12 items), 7 per cent; grass, less than 1 per cent. Silver sagebrush was most important (91 per cent of the recorded use).

Seven browse species received 97 per cent of the use recorded on the big sagebrush-grassland type; forbs (3 items), 2 per cent; grass, 1 per cent. Big sagebrush and rubber rabbitbrush were the most frequently used browse plants (68 per cent).

Sprouted grain received 100 per cent of the use recorded on the seeded portion of grain fields.

Winter (December 1-March 15)

Thirteen rumen samples (2 December, 4 January, 6 February, 1 March) were analyzed. Browse represented 70 per cent of the sample volumes; forbs, 2 per cent; sprouted grain, 5 per cent; waste grain, 23 per cent. Grass amounted to less than 1 per cent.

Browse was present in all samples. It was the predominant forage in nine where quantities ranged from 79 to 100 per cent. Three samples had silver sagebrush as the major food (79 to 100 per cent). Six had big sagebrush as the major food (65 to 100 per cent). Silver sagebrush was present in four of these samples. Amounts ranged from a trace to 35 per cent. Six of the nine samples were from animals collected on one or the other of the sagebrush-grassland types. Three were from animals collected on grassland (one adjacent to a grain field).

Forbs were present in all but two samples. Quantities in six ranged from 1 to 7 per cent. In five others forbs were present only as trace items.

Grass was present in all but three samples. It represented 2 per cent of the contents in the one March sample and occurred as a trace in nine others.

Sprouted grain was present in one sample where it represented 66 per cent of the contents. Browse, primarily big sagebrush, represented 24 per cent; waste grain, 9 per cent; forbs, 1 per cent. This sample was collected in February during the second year of the study. It was from an animal on the type where big sagebrush was dominant. The collection site was adjacent to a grain field.

Waste grain was also present in four other samples. All were obtained during the first year of the study. It was the predominant forage in three where quantities ranged from 88 to 92 per cent. Amounts in the other sample represented 21 per cent of the contents. Silver sagebrush made up the remaining 79 per cent. Two of the four samples were from animals collected on grain fields. The two others were from animals collected on grassland adjacent to grain fields.

A total of 10,837 instances of plant use was recorded at 52 feeding sites as follows: grassland—1,942 instances of use, 8 sites; silver sagebrush-grassland—3,391, 23; big sagebrush-grassland—4,951, 16; grain fields—553, 5.

Six browse species received 97 per cent of the use recorded on the grassland type; forbs (6 items), 3 per cent. Grass use was not detected. Common winterfat, big sagebrush, silver sagebrush and fringed sage were the most frequently used browse species (95 per cent).

Five browse species received 99 per cent of the use recorded on the silver sagebrush-grassland type; forbs (3 items), 1 per cent. Grass use was not detected. Silver sagebrush was most important, receiving 96 per cent of the recorded use.

Six browse species received almost 100 per cent of the use recorded on the big sagebrush-grassland type. Forb (4 items) and grass use amounted to less than 1 per cent. Big sagebrush was most important, receiving 79 per cent of the recorded use.

Sprouted grain received 100 per cent of the use recorded on the seeded portion of grain fields.

Yearlong Trends

The data suggested the following general food habits for antelope on the study area.

During spring, fall and winter, browse was the predominant food of antelope which used rangeland vegetation exclusively. Silver sagebrush and big sagebrush were the most important species, but appreciable amounts of western snowberry were utilized during late spring and early fall. Browse, especially western snowberry, was also an important antelope food during summer. All three of the rangeland types served as sources of browse. The two sagebrush-grassland types appeared to be particularly important as sources of their dominant browse species.

Forbs were indicated to be the predominant food of antelope during summer. They were also utilized to an appreciable extent during late spring and early fall. Antelope using grain fields during spring and summer obtained forbs from the seeded and fallow portions of fields. The three rangeland types also served as sources of forbs. The grassland type appeared to be particularly important as a source of forbs during the spring, summer and fall. The most important species on the rangeland types were aster and meadow salsify; on the grain field type, knotweed, bindweed, sunflower and dandelion.

Grass was a minor antelope food at all times. Relatively greater amounts of grass were utilized during the last two months of spring. Grass received less use than browse or forbs on the three rangeland types during all seasons, but it was the predominant class of forage utilized on the crested wheat, hay field type during spring.

Sprouted grain appeared to be an important antelope food during the fall and winter seasons when it was readily available. It was also used during spring and summer. Late summer use approximated that which occurred during fall. The seeded portions of grain fields were indicated to be the primary source of sprouted grain, but it was also obtained from stubble and fallow portions of fields.

Waste grain apparently served as an important antelope food during the winter and early spring. It was indicated to be particularly important during the first year of the

study when sprouted grain was not readily available. Waste grain was obtained from the stubble portions of harvested wheat or barley fields.

In averaging the seasonal data, browse represented 62 per cent of the 41 rumen samples; forbs, 20 per cent; waste grain, 10 per cent; sprouted grain, 6 per cent; grass, 3 per cent.

ANTELOPE USE OF GRAIN FIELDS

Fields Used

The continuity of the grain field type on the northern third of the study area precluded attempts to express relative intensities of use on individual fields. Certain fields were used more intensively than others. Their proximity to large tracts of rangeland appeared to be an important factor.

Of the total 6,385 antelope observed on grain fields, 5,673 (89 per cent) were less than one-half mile from rangeland; 712 (11 per cent) one-half to one mile. Numbers observed less than one-half mile from rangeland during the four seasons were as follows: spring, 643 (86 per cent of the spring total); summer, 678 (100 per cent); fall, 2,170 (95 per cent); winter, 1,895 (71 per cent). Similar data for numbers observed one-half to one mile from rangeland were as follows: spring, 106 (14 per cent); summer, 0; fall, 124 (5 per cent); winter, 769 (29 per cent).

The data indicate that grain fields within one-half mile of rangeland received the greatest antelope use during all seasons. Fields one-half to one mile from rangeland were used to an appreciable extent only during winter.

Numbers Using Fields

A total of 2,416 antelope was observed on grain fields during the first year of the study (May 1955, to May 1956); 3,969 the second year (May 1956, to May 1957). These observations were from 119 days of route travel the first year; 136 days the second. Seasonal periods and the number of days routes were traveled for the first and second year respectively were as follows: spring (March 16 - May 31), 21 and 31; summer (June 1 - September 12), 47 and 36; fall (September 16 - November 30), 29 and 27; winter (December 1 - March 15), 22 and 42.

The greatest number of antelope (unduplicated) observed on grain fields during any one day of a seasonal period was used to indicate relative numbers involved in field use on the western and eastern sections of the study area.

The seasonal periods of the first year and the greatest number observed on fields in the western section during any one day were as follows: spring, 2 on May 25; summer, 21 on August 29; fall, 30 on November 8; winter, 6 on February 27. Similar data for the second year were as follows: spring, 17 on March 18; summer, 6 on August 28; fall, 28 on October 22; winter, 81 on January 7.

The seasonal periods of the first year and the greatest number observed on fields in the eastern section during any one day were as follows: spring, 77 on March 19; summer, 27 on August 26; fall, 88 on November 2; winter, 144 on February 17. Similar data for the second year were as follows: spring, 66 on March 16; summer, 38 on September 3; fall, 159 on November 30; winter, 156 on March 14.

The data suggest that greater numbers of antelope were involved in grain field use on the eastern section of the study area during all seasons. The greatest number observed on fields during any one day was 144 during the winter of the first year, 159 during the fall of the second. These figures represent 77 and 65 per cent of the greatest number observed during any one day on the entire eastern portion of the study area for the first and second years respectively (see section on intensities of field use).

By contrast, the greatest number observed on fields within the western section during any one day was 30 during the fall of the first year; 81 during the winter of the second. The 30 and 81 head represent 11 and 29 per cent of the total antelope counted on the western section during the August 1955, aerial census. Ground counts, to approximate total numbers wintering on the western section, were unreliable. The majority of the antelope wintered in a portion of the rough "breaks" area where access was limited. Actual numbers wintering on the western section during the two years of the study were believed to be greater than the number counted during the August aerial census. Fall hunter harvests were light due to landowner closures and the area served as a winter range for some antelope which spent the summer outside the study area boundaries (see section on movements).

The apparent differences in numbers of antelope using grain fields on the two sections of the study area appeared to be partially related to supplies of browse (primarily big sagebrush and silver sagebrush). The sagebrush-grassland types were more extensive on the western section where fewer antelope used fields. Levels of utilization on big sagebrush and silver sagebrush were generally light. On the eastern section both species of sagebrush were fully utilized on sites adjacent to fields by late fall and on all sites, with the exception of the "breaks" area, by spring. Cattle, which were permitted to forage on rangeland during winter, were responsible for some of the utilization on silver sagebrush. The use of silver sagebrush by cattle has been reported by Holscher and Woolfolk (1953).

The food habits study suggested that sprouted or waste grain may be a substitute for silver sagebrush or big sagebrush in the winter and early spring diet of antelope. Fall use of sprouted grain was apparently a matter of animal preference since supplies of browse were generally adequate at this time. Admittedly, the relationship of browse supplies to numbers using fields is not entirely clear. Possibly, shortages of browse and acquired tastes for both sprouted and waste grain interact to induce greater numbers of antelope to use fields on the eastern section.

Sex, Age Classes and Social Habits of Antelope Using Fields

Of the 6,385 antelope observed on grain fields, 6,358 were classified as to age and sex. Adult male, yearling male, female and fawn classes were distinguished by using characters and procedures described by Cole (1956). In this study animals born in the spring (usually late May) of any one year were classed as fawns up to May 16 of the following year. From this date on, male animals (previously classed as fawns) were classed as yearlings until they shed their characteristic horns in winter (at approximately 18-20 months of age).

The various sex and age classes were observed on fields as single individuals or in groups of two or more individuals. Different associations of the sex and age classes comprised groups. The five group associations recognized were as follows: No. I, female(s) - fawn(s); No. II, one male - female(s)

with or without fawns; No. III, two or more males - female(s) with or without fawns; No. IV, two or more males; No. V, two or more fawns. Numbers of antelope observed as single individuals and the numbers observed in the various groups were tabulated. The results are shown in Table 4.

The data show that all sex and age classes used grain fields. Eighteen of the 38 single individuals were adult males, 15 were females, four were yearling males and one was a fawn. Antelope using fields were mostly in groups. The majority of the animals observed on fields during summer were in groups which were associations of one adult male with females or females and fawns. As observed during an earlier study (Cole *op. cit.*), the adult males in these groups were resident to restricted areas (territories) and females and fawns moved between the territories of several males. The majority of these males appeared to be resident to their territories for a period extending through late spring and summer. During this period, other adult males (believed to be younger animals) and yearling males occurred in bachelor herds. The association of these males with females and fawns was curtailed by their aggressive sexual behavior and the intolerance of adult males on territories toward other males. The aggressive sexual behavior of bachelor herd males caused females and fawns to avoid them. The intolerant behavior of adult males on territories served to create sanctuaries where females and fawns were not molested by bachelor herd males.

The majority of the antelope observed on grain fields during spring, fall and winter were in groups which were associations of two or more males with females or females and fawns. These associations were practically absent from fields during summer. Their prevalent occurrence on fields in fall coincided with heightened male sexual activity. Males from bachelor herds intensified their attempts to associate with females. Males habitually attending females on territories attempted to prevent such associations, but with the onset of the breeding season (late September and October) they frequently deserted their attended groups for the company of single females. This periodic dissolution of the territory as a sanctuary resulted in considerable social disorder. Groups, previously attended by single adult males, were broken up by the males which invaded territories.

Table 4.—Numbers of antelope observed as single individuals and the numbers observed in various groups by seasonal periods from May 1955, to May 1957. Group I, female(s)-fawn(s) ; II, one male-female(s) with or without fawns; III, two or more males-female(s) with or without fawns; IV, two or more males; V, two or more fawns. (*=less than 1 per cent)

| Seasonal Periods | Total Antelope Observed | | Single Individ. | | I | | II | | Groups III | | IV | | V | |
|------------------------------------|-------------------------------|----|--------------------|-----|-----|-----|-----|------|---------------|-----|-----|----|-----|---|
| | | | | | No. | | No. | | No. | | No. | | No. | |
| | | | No. | % | No. | % | No. | % | No. | % | No. | % | No. | % |
| Spring..... (Mar. 16 - May 31) | 745 | 11 | 1 | 147 | 20 | 135 | 18 | 432 | 58 | 13 | 2 | 7 | 1 | |
| Summer..... (June 1 - Sept. 15) | 678 | 15 | 2 | 190 | 28 | 354 | 52 | 8 | 1 | 111 | 16 | 0 | | |
| Fall..... (Sept. 16 - Nov. 30) | 2065 | 10 | * | 64 | 3 | 219 | 11 | 1737 | 84 | 32 | 1 | 3 | * | |
| Winter..... (Dec. 1 - Mar. 15) | 2870 | 2 | * | 111 | 4 | 140 | 5 | 2601 | 91 | 12 | * | 4 | * | |
| Yearlong..... | 6358 | 38 | 1 | 512 | 8 | 848 | 13 | 4778 | 75 | 168 | 3 | 14 | * | |

Males previously compatible in bachelor herds became intolerant of other males. The presence of females, rather than any affiliation with a territory, appeared to be the motivating factor. With the waning of male sexual activity in November, all males appeared to tolerate each other. The various sex and age classes combined in large groups. The behavior of males (previously on territories and in bachelor herds) in these groups was irrelevant in affecting their social structure. This state of relatively passive male behavior persisted through winter and early spring. The break-up of groups containing all sex and age classes in late spring coincided with the re-establishment of adult male territories, the dispersal of females into fawning areas and the association of yearling males and certain adult males into bachelor herds.

The occurrence of female or female and fawn groups on fields generally represented a temporary departure from the attendance of an adult male in late spring and summer, an association of all sex and age classes in fall, winter or early spring. Groups of fawns generally represented temporary departures from associations where adults were present.

Movements In Relation To Grain Fields

Each of 125 antelope was tagged with plastic ear markers (Johnson, 1951). Ninety-three were tagged on the western section of the study area during December of 1954. They were captured by running them into a trap with an aeroplane. Incisor replacement criteria (Dow, 1951) were used to separate tagged animals into fawn, yearling and adult classes. On the eastern section, 32 were captured and tagged as fawns during late May or June of 1955 and 1956. Five adult males were recognizable by horn peculiarities. A total of 751 relocations (observations after tagging or initial recognition) was accomplished with a spotting scope equipped with 25 and 40 power oculars. Ten additional relocations were obtained from marked animals which were collected for the food habits study or killed by hunters. Relocations were plotted on four inch to the mile aerial photos or one-half inch to the mile maps.

The Study area was approximately 14 miles long in a north-south direction on the western section; 12 miles on the eastern section. Progressively greater amounts of land

were in grain fields from south to north, but at no place on the study area was it possible for an antelope to be more than about two miles from a grain field. Grain fields occurred more extensively about nine miles from the southern boundary of the western section, but sizable tracts of rangeland bordered drainage courses or occurred as isolated tracts within the cropland type. Grain fields occurred more extensively about six miles from the southern boundary of the eastern section. Tracts of rangeland were limited, but one sizeable area paralleled a drainage course extending through the extensive grain field type (Fig. 1). On both sections of the study area, antelope moving 10 or more miles from winter ranges were well within the extensive grain field type. Six marked animals were identified at points ten or more miles from their winter range on the western section; one on the eastern section (Fig. 5).

Antelope No. 94 was tagged as a male fawn on May 25, 1955. From May 30, 1955, to April 30, 1957, he was relocated 77 times. The greatest airline distance between any two locations was about ten and one-half miles. The most northward relocation was on October 24, 1955. He was associated with a group of two females, three other fawns, one yearling

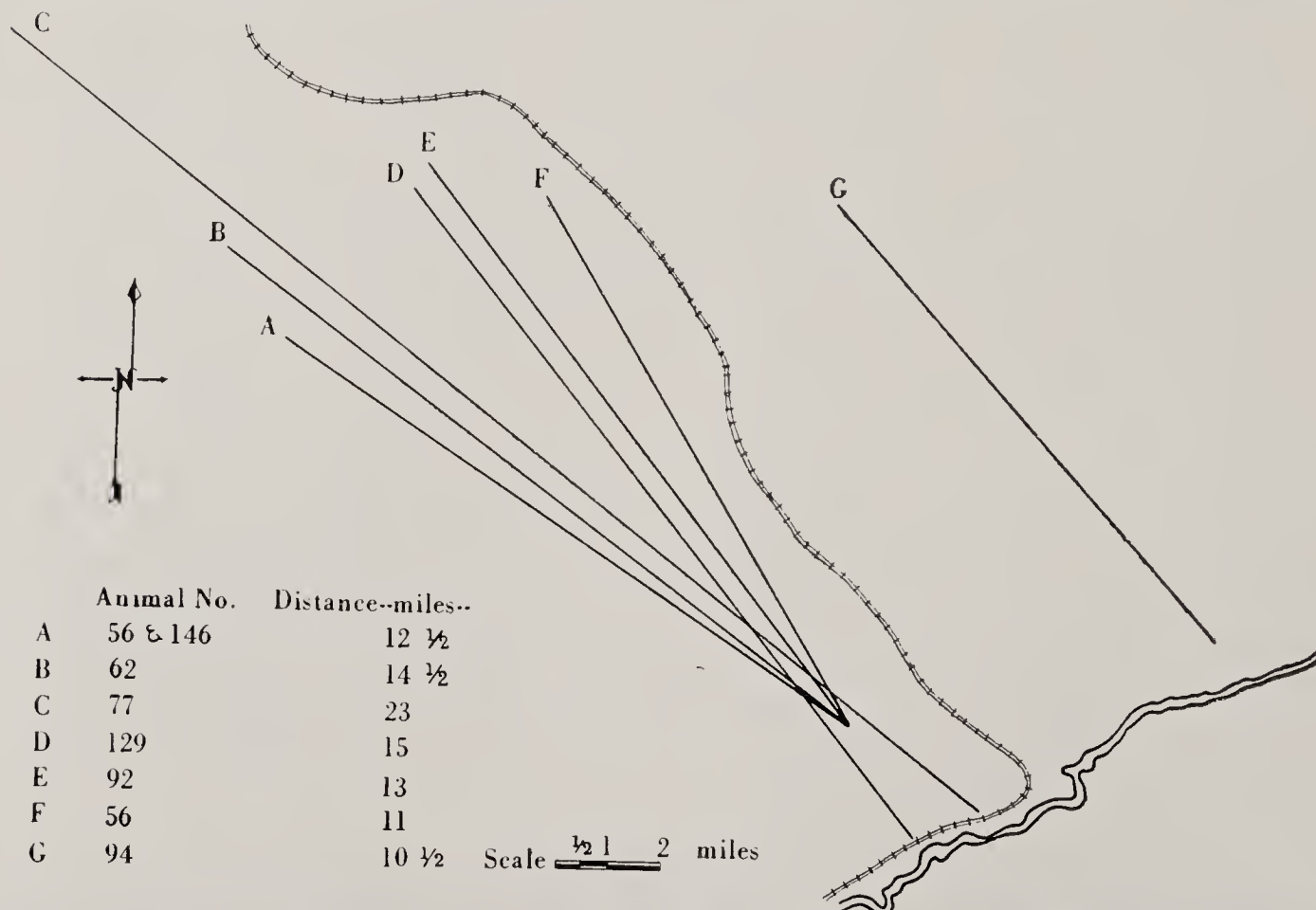


Fig. 5. Maximum distances between points where seven marked antelope, moving 10 or more airline miles, were observed.

male and one adult male. The most southward relocation was on December 8, 1955. He was associated with 34 females and fawns on the "breaks" portion of the winter range.

Antelope No. 56 was tagged as an adult female on December 24, 1954. From October 26, 1955, to May 30, 1956, she was relocated six times. No relocations were made south of the "breaks" portion of the winter range area she and her associates occupied prior to being driven to the trap (about two miles away). The greatest distances she was relocated from this winter range area was about 11 miles on October 6, 1955; about 12½ miles on May 11, 1956. She was associated with a large group comprised of all sex and age classes on December 24; with seven females, two fawns and one adult male on October 26; five females, two female fawns (short yearlings) and one adult male on May 11.

Antelope No. 92 was tagged as a fawn on December 23, 1954. From July 22, 1955, to November 4, 1955, she was relocated 10 times. The greatest distance she was observed from the winter range area occupied prior to tagging was about 13 miles on August 3, 1955. She was associated with six females, three fawns and one adult male. Only two females in the group appeared to be full adults. The other females were similar in appearance to No. 92 and were classed as yearlings.

Antelope No. 129 was tagged as a fawn on December 23, 1954. From May 19, 1955, to June 13, 1956, she was relocated seven times. The greatest airline distance between two relocations was about 15 miles. The most southward relocation was on April 17, 1955. She was associated with two females and two other fawns (short yearlings) on the "breaks" portion of the winter range on the western section. The most northward relocation was on May 29, 1956. She was with two other females.

Antelope No. 77 was tagged as an adult female on December 23, 1954. She was relocated three times. The most southward relocation was on November 29, 1955. She was in a group of 133 animals which were on the "breaks" portion of the winter range during a period of severe storms. She was relocated on the same general winter range on January 26, 1956, but about three miles northwest. On September 15, 1957, she was killed by a hunter. The kill site was outside the boundaries of the study area and was about 23 airline miles from the November 29 relocation.

Antelope No. 62 was tagged as an adult female on December 24, 1954. On October 10, 1955, she was killed by a hunter about 14½ miles from the winter range area she had occupied prior to tagging.

Antelope No. 146 was tagged as an adult male on December 23, 1954. On October 9, 1955, he was killed by a hunter about 12½ miles from the winter range area he had occupied prior to tagging. The kill site was just outside the boundaries of the study area.

The data suggest that substantial numbers of antelope on the western section travel considerable distances between a winter range and an outlying summer and fall range which was within the extensive grain field type. The greatest number of antelope observed in one day on the outlying range areas (10 or more miles from the south boundary of the "breaks" winter range) was 67 during the first year of the study; 81 the second. All antelope observed in these outlying range areas were on or adjacent to tracts of rangeland. Isolated tracts necessitating travel over the grain field type for distances up to three-fourths mile were occupied.

Fewer antelope were indicated to be involved in extensive movements on the eastern section of the study area. This was attributed to the lack of rangeland areas within the grain field type on the northern part of this section. The one antelope group known to be involved in extensive movements established summer and fall residence on the narrow tract of rangeland extending through the grain field type.

The data also suggest that the majority of the antelope on both sections remained within ten miles of the southern boundary of the study area during all seasons. Observations of both marked and unmarked antelope indicated that seasonal ranges were less distinct on this portion of the study area. Antelope used areas north and west of the southern "breaks" area to a greater extent during spring, summer and fall, but they commonly dispersed four to five miles into these same areas during periods of mild winter weather.

Classification data from all antelope observed on outlying range areas (10 or more miles from the winter range) supported the data from marked animals in indicating that

adult females, fawns, females approximately one year old and adult males were the sex and age classes most involved in extensive movements. Only four yearling males were seen on the outlying range areas during the study. Since fawns were born after adult females arrived on the outlying range they were only involved in extensive movements when they accompanied older animals or the return trek to the winter range. The first severe snow storms appeared to cause antelope to leave outlying range areas.

Intensities of Field Use

Antelope were observed on the stubble, seeded and fallow portions of grain fields. Average numbers observed per day were calculated to indicate relative intensities of seasonal use. Seasonal values were averaged to indicate relative intensities of yearlong use. The results are shown in Table 5.

The data suggested that grain fields received intensities of antelope use which were relatively light during spring and summer, moderate or heavy during fall and heavy during winter. Fields received greater use during the second year of the study. Only the stubble and seeded portions of fields received moderate or heavy intensities of use. Total use on stubble portions was greater than that on seeded portions the first year. Total use on stubble and seeded portions was approximately equal the second year. For both years, use on stubble portions was at a maximum during winter. Use on seeded portions was at a maximum during fall.

The differences in field use for the two years appeared to be related to differences in antelope populations and weather conditions. Numbers of antelope observed per day were calculated for the eastern section of the area where fields received the greatest use. The maximum (unduplicated) number observed during any one day was 187 on February 17 of the first year, 244 on November 2 of the second year.

August, September and October precipitation was very low the first year, averaging .15 (.00-.23) inches. Only limited amounts of winter wheat sprouted on the seeded portions of fields. Precipitation for these same months was relatively high the second year, averaging 1.33 (.54-2.21) inches. Winter wheat sprouted luxuriantly and was readily available for use.

Table 5.—Numbers of antelope observed on grain fields by seasonal periods during the first and second years of the study. *==less than 1 per day.

| | Spring | | Summer | | Fall | | Winter | | Yearlong | |
|-------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| | 1st year | 2nd year | 1st year | 2nd year | 1st year | 2nd year | 1st year | 2nd year | 1st year | 2nd year |
| Number of days routes were covered | 21 | 31 | 47 | 36 | 29 | 27 | 22 | 42 | 119 | 136 |
| Total antelope observed on fields | 259 | 490 | 264 | 414 | 735 | 1348 | 1158 | 1717 | 2416 | 3969 |
| Average number observed per day | 12 | 16 | 6 | 12 | 25 | 50 | 53 | 41 | 24 | 30 |
| Average number observed per day on: | | | | | | | | | | |
| Stubble portions | 10 | 5 | 2 | 5 | 16 | 19 | 51 | 22 | 20 | 12 |
| Seeded portions | 2 | 10 | * | 5 | 8 | 23 | 2 | 15 | 3 | 13 |
| Fallow portions | 0 | 1 | 4 | 2 | 1 | 8 | 0 | 4 | 1 | 5 |

Severe snow storms, accompanied by low temperatures, caused antelope to leave grain fields and congregate in rough "breaks" areas where the vegetation was predominantly one or the other of the sagebrush-grassland types. These two types were also heavily used by antelope during moderate winter weather, but to a lesser extent.

During the late fall and early winter of the first year, grain field use was sharply curtailed by snow storms which started on November 11 and continued periodically through December. Prior to this stormy period, a total of 603 antelope was observed during 6 days of November route coverage. Of this total, 48 per cent were observed on grain fields, 9 per cent on grassland and 43 per cent on one or the other of the sagebrush-grassland types. During the stormy period, a total of 1,552 antelope was observed during 10 days of November and December route coverage. Of this total, 5 per cent were observed on grain fields, 12 per cent on grassland and 83 per cent on one or the other of the sagebrush-grassland types. After the stormy period, a total of 1,530 antelope was observed (10 days) during the relatively mild weather of January. Of this total, 32 per cent were observed on grain fields, 20 per cent on grassland and 48 per cent on one or the other of the sagebrush-grassland types.

More or less similar patterns of antelope use occurred throughout the winters of both years, coinciding with the incidence and abatement of storms.

Monthly Use of Seeded Portions

The second year data (May 1956, to May 1957) which show greater use of seeded portions were further analyzed to indicate relative intensities of use by monthly periods.

An average of one antelope per day (14 days) was observed on seeded portions during May (a month when most females sought out rangeland areas for fawning). About 10 per day (5 days) were observed during June, 7 per day (14 days) during July, 3 per day (12 days) during August and less than one per day (10 days) during September. About 12 per day (11 days) were observed during October, 44 per day (11 days) during November and 21 per day (12 days) during December. About 17 per day (11 days) was observed during January, less than 1 per day (13 days)

during February (a month of severe storms), 29 per day (12 days) during March and 11 per day (11 days) during April.

The data show that intensities of use were relatively heavy (about 20 or more per day) from November 1 to March 31, relatively light (about 10 per day) during April, June and October and relatively minor (less than 10 per day) during May, July, August and September.

Effects of Antelope Use on Grain Fields

On January 1, 1957, three plots were established on seeded portions of a wheat field which had received relatively heavy antelope use during the late winter and spring of 1956. This field also received relatively heavy use during 1957. Each of the three plots contained three 20 by 30 foot sub-plots. Distances between sub-plots were approximately 10 feet. The treatments received by each set of three sub-plots were as follows:

| <i>Sub-Plot</i> | <i>Treatments</i> |
|-----------------|--|
| 1 | Enclosed within an antelope-proof fence |
| 2 | Antelope use plus ground level clipping on May 1 or 19, 1957 |
| 3 | Antelope use |

Four sub-plots were destroyed by agricultural operations during the year. On July 17 and 18, 1957, wheat plants were clipped from four 25 foot rows within each of the five remaining sub-plots. Weights of grain heads in each row were measured to 0.1 gram. Results are shown in Table 6.

Data from plot 1 was subjected to a "Student's" t-test. The hypothesis that the mean yields from sub-plots 1 and 2 were equal could not be rejected at the 10 per cent level. The calculated value of t was 1.06. The results of this statistical analysis show that we were unable to demonstrate any changes in wheat yields due to the treatment involving antelope use plus ground level clipping on May 1. The results are at variance with Hubbard and Harper (1949). They found that severe clipping after the termination of winter dormancy (about mid-February in Oklahoma) reduced grain yields. In the present study, plants were actively growing and about 4 inches in height when they were clipped on May 1.

Table 6.—Weights of seedheads (in grams) from wheat plants in four rows within each of five sub-plots receiving various treatments.

| Plot 1 | | Plot 2 | | |
|------------|------------|------------|------------|------------|
| Sub-plot 1 | Sub-plot 2 | Sub-plot 1 | Sub-plot 2 | Sub-plot 3 |
| 633.9 | 485.0 | 358.4 | 281.8 | 356.9 |
| 541.1 | 407.4 | 330.6 | 255.4 | 190.8 |
| 481.9 | 543.2 | 599.2 | 363.4 | 537.1 |
| 471.2 | 494.4 | 555.9 | 271.5 | 473.1 |

Data from plot 2 was also subjected to “Student’s” t-tests. The hypothesis that mean yields from sub-plots 1 and 2 were equal was rejected at the 10 per cent level ($t = 2.38$). The hypothesis that mean yields from sub-plots 1 and 3 were equal could not be rejected at the 10 per cent level ($t = 0.77$). The results of these statistical tests indicate that grain yields were reduced by the treatment involving the antelope use plus ground level clipping. Changes in yields due to the treatment involving antelope use alone could not be demonstrated. This suggests that the ground level clipping on May 19 was the primary reason for the differences in yields between sub-plots 1 and 2. Wheat plants clipped on May 19 were about 12 inches in height and culm elongation was assumed to be in progress. The period of culm elongation in central Montana is generally between the 15th and 25th of May (Krall, pers. comm., 1958). Moderate clipping or grazing (by livestock) of wheat within this period or later (when seedheads could be taken) has been found to reduce yields (Swanson 1935, Hubbard and Harper *op. cit.*). These same workers and Sprage (1935) found that moderate clipping or grazing on growing wheat prior to the period of culm elongation (fall or spring) did not reduce wheat yields. Pirnie (1954), working with wheat in the dormant winter stage, reported that even the heaviest intensities of grazing by wild geese did not have a detrimental effect on yields.

In the present study the intensity of grazing on growing or dormant wheat could not be considered severe, even on the fields receiving the greatest antelope use. This was attributed to the tendency for the animals to distribute their grazing over relatively large areas of the grain field type.

An apparent increase in the mobility of large antelope groups, as compared to small groups, appeared to compensate for the intensities of grazing which resulted when large groups used fields. Similar increases in mobility as a result of increases in group size has been reported for the red deer (*Cervus elaphus*) by Darling (1937).

On this study area, it would appear that the critical period when antelope grazing would have a detrimental effect on wheat yields is from the time culms start to elongate (about May 15) until the grain is harvested (July or August). Observations indicated that relatively few antelope used the seeded portions of grain fields during this period (see section on intensities of field use and monthly use of seeded portions). In addition, the food habits study indicated that weedy forbs were the major class of forage used by antelope feeding on the seeded portions of grain fields during the summer.

Antelope commonly bedded on grain fields. The fallow and seeded portions of wheat fields were most available during the summer months prior to the grain harvest. During this period, antelope appeared to avoid bedding on the seeded portions of fields where their vision would have been obstructed by standing grain. In the two years of this study, a total of 18 bedded antelope was observed on the seeded portions of fields during June and July. Thirteen were on a small field where the grain was sparse and weed infested. The grain was later cut for hay. Five were on the portion of a field where the grain was sparse and weed infested as a result of a "blowout." No antelope were observed to bed in standing grain during August. Beds in standing grain are noticed by combine operators at the time grain is harvested. These beds are usually attributed to antelope, but they are more likely those of mule deer (*Odocoileus hemionus*). Mule deer were observed to bed in standing grain during this study.

The stubble and seeded portions of wheat fields were most available during fall, winter and spring. Bedding occurred on either portion. Antelope frequently pawed the ground prior to bedding. An occasional wheat plant was pawed out on the newly-seeded portions of fields, but observations indicated that this type of damage was not extensive enough to cause concern.

Trampling effects were apparent on two trails which crossed grain fields. Wheat plants were noticeably reduced on one trail which antelope had repeatedly used in traveling to and from the aforementioned "blowout" site which was used as a summer feeding area. Plants were similarly reduced on another trail which a large group of antelope had repeatedly used in crossing a field during the winter. Antelope usually chose rangeland for avenues of travel, but this field was unusually situated. It extended over one mile into a large tract of rangeland. Antelope chose the shorter route across the relatively narrow width (about $\frac{1}{4}$ mile) of the field in traveling between frequented rangeland areas. A small group of antelope also used the trail across this field in traveling to and from a water reservoir during the summer.

Several ranchers on the study area commonly grazed cattle on wheat fields, alleging non-harmful or even beneficial effects on yields. The soil disturbance and trampling of wheat plants which resulted from cattle grazing appeared to be much greater than that which resulted from antelope using fields.

SUMMARY

1. A two year study of antelope habits was conducted on a 184 square mile area in central Montana. Principal forms of land use were wheat farming and cattle raising. Antelope depredations on wheat crops had been reported. All lands were privately-owned or leased.
2. A railroad track divided the study area into a western section of approximately 126 square miles and an eastern section of 58 square miles. Cropland and rangeland comprised about 20 and 80 per cent of the general study area respectively. The northern third of the study area was predominantly cropland. Cropland types were grain fields and hay fields. Winter wheat fields comprised practically all of the cropland type. Rangeland types were grassland and sagebrush-grassland. Two kinds of sagebrush-grassland were recognized. The grassland type was extensive and comprised the greater portion of the rangeland available to antelope. The two sagebrush-grassland types represented a relatively small portion of total rangeland area.

3. Recorded observations of antelope occurrences on rangeland and cropland types along established routes indicated differences in intensities of use by seasonal periods. The data suggested that antelope used rangeland types more than cropland types during all seasons. On a year-long basis, rangeland use averaged 78 per cent of the total, grain field use 21 per cent and hay field use 1 per cent.
4. Food habits were determined from 41 rumen samples and 31,767 instances of recorded plant use at 194 antelope feeding sites. Data showing food habits in relation to seasons and the various rangeland and cropland types are presented. In averaging the seasonal data, browse represented 62 per cent of the 41 rumen samples, forbs 20 per cent, waste grain 10 per cent, sprouted grain 6 per cent and grass 3 per cent.
5. Recorded observations indicated that grain fields in proximity to rangeland received the greatest antelope use. About 89 per cent of the 6,385 antelope observed on fields were within one-half mile of rangeland. The remaining 11 per cent were within one-half to one mile of rangeland.
6. Recorded observations indicated the relative numbers of antelope using fields on the two sections of the study area. Greater numbers of antelope were indicated to use fields on the eastern section during all seasons. The greatest number observed on fields within this section was 144 during the winter of the first year of the study, 159 during the fall of the second year. These figures represented 77 and 65 per cent of the greatest number of antelope observed on the entire eastern section during the first and second years respectively. The greatest number observed on fields within the western section in any one day was 30 during the fall of the first year, 81 during the winter of the second. These 30 and 81 animals represented 11 and 29 per cent respectively of the total antelope counted on the western section during an August 1955, aerial census. The differences in numbers using grain fields on the two sections appeared to be partially related to browse supplies.

7. Classification data indicated that antelope of all sex and age classes used grain fields. Animals using fields were mostly in groups. Different sex and age class associations comprised five groups. Animals most involved in field use during spring, summer and fall were in groups which were associations of two or more males with females and fawns. Animals most involved in field use during the summer were in groups which were associations of one adult male with females and fawns. The influence of the male behavior on the social structure of antelope groups is described.
8. Relocations of marked antelope indicated that some animals traveled considerable distances (10 to 23 miles) between winter ranges and outlying summer and fall ranges. These extensive movements occurred where sizable tracts of rangeland were within the grain field type. Antelope were observed to occupy isolated rangeland tracts which necessitated their traveling about three-fourths mile across grain fields. The majority of the antelope on the study area remained within ten miles of the southern boundary of the study area during all seasons. Seasonal ranges were less distinct on this portion of the study area.
9. Average numbers of antelope seen per day on the stubble, seeded and fallow portions of grain fields indicated differences in intensities of use by seasons and years. For the two years, grain field use was relatively light (6 to 16 antelope observed per day) during spring and summer, moderate or heavy (25 and 50 per day) during fall and heavy (41 and 53 per day) during winter. Intensities of use on the stubble portions of fields was at a maximum during winter. Use on seeded portions was at a maximum during fall. Differences in use between years and the influence of snow storms are discussed.
10. Weights of grain heads were obtained from wheat plants within sub-plots receiving various treatments after January 1. Changes in wheat yields due to treatments involving antelope use plus ground level clipping on May 1 or antelope use alone could not be demonstrated. Ground level clipping on May 19 when culms were

elongating reduced yields. The critical period for affecting wheat yields by grazing was indicated to be from about May 15 until harvest time (July or August). Antelope commonly bedded on grain fields, but the seeded portions of fields were avoided during the period when their vision would have been obstructed by standing grain. Trampling effects were only apparent on single trails which crossed two fields. The soil disturbance and trampling which resulted from cattle grazing appeared to be much greater than that which resulted from antelope using grain fields.

LITERATURE CITED

- American Joint Committee on Horticultural Nomenclature. 1942. Standardized plant names. J. Horace McFarland Company, Harrisburg, Pa. 675 pp.
- Cole, G. F. 1956. The pronghorn antelope—its range use and food habits in central Montana with special reference to alfalfa. Mont. Fish and Game Dept. and Mont. St. Coll. Agr. Expt. Sta. Bull. No. 516, 63 pp.
- Darling, Fraser F. 1937. A herd of red deer. Oxford Univ. Press, London.
- Dow, S. A. 1955. An evaluation of some criteria for age determination of the pronghorn (*Antilocapra americana* Ord). Unpublished M. S. thesis, Mont. St. Univ.
- Giesecker, L. F. 1931. Soils of Chouteau County. U. S. Dept. of Agr. and Mont. Agr. Expt. Sta. Bull. No. 252, 63 pp.
- Holscher, C. E. and E. J. Woolfolk. 1953. Forage utilization by cattle on northern Great Plains ranges. U. S. Dept. of Agr. Circular No. 918, 27 pp.
- Hubbard, V. C. and H. J. Harper. 1949. Effect of clipping small grains on composition and yield of forage and grain. Agron. Jour. 41(2):85-92.
- Johnson, D. E. 1951. Biology of the elk calf, *Cervus canadensis nelsoni*. Jour. of Wildl. Mgt. 15(4):396-410.
- Martin, A. C., R. H. Gensch and C. P. Brown. 1946. Alternative methods in upland game bird food analysis. Jour. of Wildl. Mgt. 10(1):8-12.
- Pirnie, M. D. 1954. The grazing of dormant winter wheat by wild geese. Mich. St. Coll. Agr. Expt. Sta. Quar. Bull. 37(1):95-104.
- Sprage, M. A. 1935. The effect of grazing management on forage and grain production from rye, wheat and oats. Agron. Jour. 46(1):29-33.
- Swanson, A. F. 1935. Pasturing winter wheat in Kansas. Agr. Expt. Sta. Kan. St. Coll. of Agr. Bull. 271, 30 pp.

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